3.5 INFRASTRUCTURE AND DRAINAGE

This section describes infrastructure and drainage facilities at Ames Research Center.

A. Methodology

Information presented in this report was gathered using a variety of means and sources as listed below:

- GIS maps of Ames Research Center facilities that show the existing potable water, sanitary sewer, storm drain, electrical and gas systems, compiled by NASA staff.
- Schematic maps from utility providers.
- Various record drawings of Ames Research Center and surrounding areas.
- Aerial photographs and topographic maps of Ames Research Center and surrounding areas.
- San Francisco Public Utilities Commission documents
- Previous sewer and storm drain studies and reports, including sewer line videos.
- A thorough site review and limited field survey, performed by BKF, that included the establishment of invert elevations and pipe sizes for relevant manholes along storm drain and sewer lines.
- Meetings, interviews and telephone conversations with:
  - NASA staff
  - Utility companies (PG&E and San Francisco Water Department)
  - City of Sunnyvale staff
  - City of Mountain View staff
  - Sunnyvale Water Pollution Control Plant staff
  - Palo Alto Regional Water Quality Control Plant staff
- Caltrans and VTA as-built drawings

B. Existing Conditions

1. Water

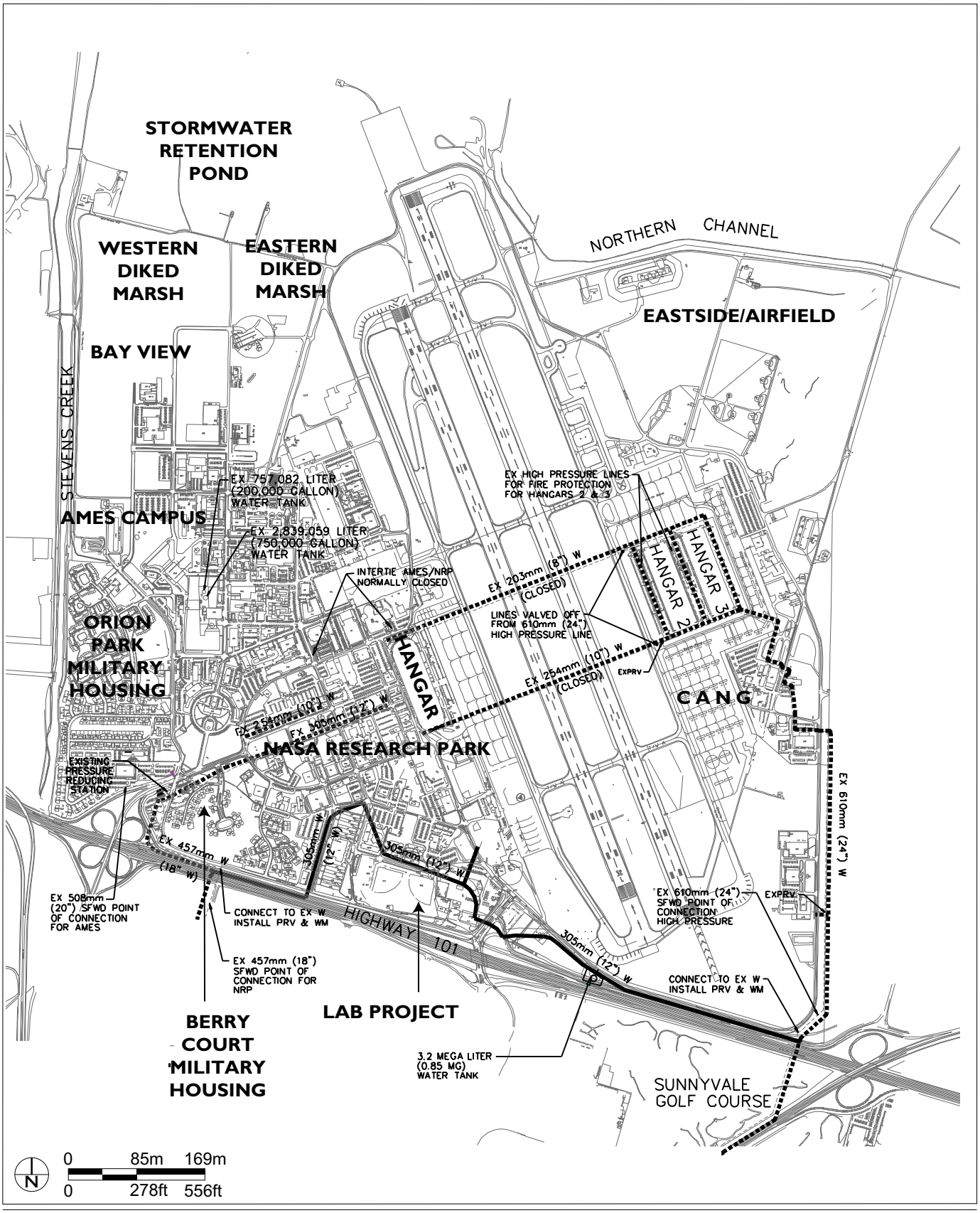
The following sections describe the existing water supply systems in the four planning areas, as shown in Figure 3.5-1.

a. Overview of the Existing System

Ames Research Center receives its potable water and fire protection supply from the San Francisco Water Department (SFWD). Approximately 85 percent of this water comes from the SFWD's Hetch Hetchy Reservoir, and about 15 percent from East Bay Municipal Utility District sources. The SFWD has indicated that the Hetch Hetchy aquaduct has sufficient capacity to serve any development that could be expected at Ames Research Center. The SFWD supply is chlorinated in Tracy, but is otherwise untreated prior to its delivery to South Peninsula water users. At Ames Research Center, water that is used in steam boilers undergoes additional softening.

NASA owns and operates the entire potable water system at Ames Research Center. The original freshwater distribution system was installed in 1932 using cast iron pipe ranging in size from 152 mm (6-inch) to 203 mm (8-inch). The overall condition of the old cast iron system is fair, requiring only routine maintenance. However, a large portion of the system has deteriorated to the point that it must be operated at a lower pressure to reduce the occurrence of leaks and other malfunctions. Some sections have needed repair in recent years, and the most problematic water lines and gate valves have been replaced.

As the distribution system has been repaired through the years, some lines have been replaced by asbestos-cement, ductile iron or plastic pipe. The present distribution system consists of over 37,000 meters (120,000 linear feet) of water line. Although most of the system is well laid out with adequate internal looping, the pipes are generally undersized and cannot provide adequate flow to meet public fire protection criteria.



Source: BKF

Existing Water Mains

Baseline Water Mains

Baseline Water Tank

FIGURE 3.5-1

BASELINE CONDITIONS WATER SYSTEM

NASA AMES RESEARCH CENTER

NASA AMES DEVELOPMENT PLAN FINAL EIS

NASA contracts directly with SFWD for the purchase of water. The current annual water demand at Ames Research Center, which is roughly 901 mega-liters (238 million gallons), is substantially less than when the base was fully occupied by Navy personnel living in the dormitories. There is no formal allocation of water from SFWD to Ames Research Center.

In January of 2001, the San Francisco Public Utilities Commission (SFPUC), which is responsible for the Hetch Hetchy water supply system, completed a Regional System Overview and Reliability Response as part of their Facilities Reliability Program. The study simulated overall SFPUC water system reliability in the event of a major earthquake on the San Andreas, Hayward, Calaveras or Great Valley Faults. The study estimates SFPUC regional water supplies would be unavailable within hours of the event to most system customers around the Bay, on the Peninsula and in San Francisco, and that service might not be restored for twenty to thirty days or longer. Until SFPUC water service is restored, most system customers, including Ames Research Center, would need to rely on local sources for fire fighting, drinking and sanitation. Full service restoration to meet average daily water demands would require an estimated six months to complete, or longer if labor, materials and equipment were difficult to obtain. The report recommends that storage facilities be able to withstand seismic trauma.

Generally accepted design practices call for storage to provide three days of domestic water use and flow to fight the design fire. For the baseline conditions at Ames Research Center, this equates to roughly 11.4 million liters (3 million gallons) of storage, which could be distributed anywhere on the site. Current existing storage is limited to 3.6 million liters (950,000 gallons), most of which is for the foam fire system used to protect Buildings N-211 and N-248 in the Ames Campus.

b. NRP Area

The primary water supply to Ames Research Center comes into the NRP Area from an SFWD meter at Tyrella Street. SFWD provides service to a 460 mm (18-inch) diameter branch from a multiple-metered vault served by a 4600 mm

(180-inch) diameter aqueduct. Pressure is reduced from 830 kilopascals(kPa) (120 pounds per square inch (psi)) to 310 kPa (45 psi) at the main meter vault for distribution. Flow is metered through two 150 mm (6-inch) meters that have a total capacity of up to 19,000 liters per minute (5,000 gallons per minute(gpm)).

The water distribution system in the NRP area is in worse condition than that of the remainder of Ames Research Center. To minimize leaks and localized failures in the system, the operating pressure within the NASA Research Park has been reduced to 45 psi. For this reason, inter-ties to other areas of Ames Research Center have been closed off, as discussed in more detail below. On-going maintenance and repair has kept the NASA Research Park system operational and eliminated the most serious deficiencies. Within the past 4 years, the main line that runs along South Akron Road was replaced with 300 mm (12-inch) ductile iron pipe. A parallel line located in North Akron Road was also replaced with a 250 mm (10-inch) PVC pipe. While this has increased the capacity of the system substantially, the operating pressure is still limited by the weaker portion of the system.

The NASA Research Park water system is connected to both the Ames Campus area and the Eastside/Airfield water systems. The Ames Campus water system connects to the NASA Research Park system by two 200 mm (8-inch) valves, located along Bushnell Street at McCord and Cummins Avenues. The valves are normally closed because of the difference in pressure between the two systems. The NASA Research Park system could be damaged due to the higher operating pressure of the ARC system.

The Eastside/Airfield water system connects to the NASA Research Park system by two lines that cross under the runway. They are 200 mm (8 inches) and 250 mm (10 inches) in diameter. The valves on these lines are located in the middle of the runway infield. The two valves are normally closed because of the large difference in pressure between the two systems. The NASA Research Park system would be damaged if the valves were opened due to the high operating pressure of the Eastside/Airfield system.

Fire flow is provided through the potable water distribution system. Hydrants are flushed annually and flow checks are performed every 5 years. Fire hydrants are also used periodically for irrigating landscaped areas. The fire capacity design for Ames Research Center is not based on the largest building size because the larger buildings have sprinkler systems. The fire marshal for Ames Research Center has set the minimum fire capacity for new systems at 5,700 liters per minute (1,500 gpm) at 140 kPa (20 psi) residual as required by the Uniform Fire Code. The most recent fire hydrant report (April 2000) shows a range of flows with many hydrants providing less than 3,800 liters per minute (1,000 gpm), with the lowest being less than 2,300 liters per minute (600 gpm).

A 740,000 liter (200,000-gallon) elevated tank is located within the NASA Research Park east of Shenandoah Plaza. The tank is old, unused and currently contains a small amount of stagnant water. There is some concern that this water could leak into the main system and contaminate the water. The tank could not be placed into service without removing the contaminated water and cleaning the tank. A pump station would have to be installed adjacent to the tank both to fill the tank and to boost the pressure of water drawn from the tank to supply the distribution system. Structural seismic retrofits would also be required.

The water supply for the Berry Court housing area is drawn from the NRP distribution system.

c. Ames Campus and Bay View Areas

The Ames Campus is serviced by a 510 mm (20-inch) asbestos cement pipe that runs parallel to the Highway 101 North on-ramp along Moffett Boulevard and feeds the Ames Campus area at 410 kPa (60 psi) to 450 kPa (65 psi). This main feed also serves Orion Park Military Housing and there are several interties between the two areas.

Fire flow is provided through the potable water distribution system, with a hydrant maintenance program similar to that employed in the NRP area. The

fire protection capacity of the Ames Campus is greater than that in the NRP area due to the higher operating pressure and better condition of the pipes. However, the area is fed from a single source with no open connections to the NRP area and Eastside/Airfield loops. The Ames Campus water system is connected to the NASA Research Park system by two 200 mm (8-inch) valves that are normally closed. These closed valves limit the redundancy of the fire protection system.

There are two storage tanks located near the ARC wind tunnels that have a combined capacity of approximately 3.6 mega-liters (950,000 gallons) of water. The larger tank (2.8 mega-liters (750,000 gallons)) is situated at grade and provides water for the foam fire protection system that is used for Buildings N-211 and N-248. The smaller tank (0.8 mega-liters (200,000 gallons)) is elevated and, according to NASA engineering personnel,[1] is currently only filled to partial capacity due to seismic concerns.

d. Eastside/Airfield

The Eastside/Airfield is serviced by a 610 mm (24-inch) feed from SFWD's 4,600 mm (180-inch) diameter aqueduct near the intersection of Highways 101 and 237, entering Ames Research Center east of the runway. The 610 mm (24-inch) line runs parallel to Macon Road. Pressure is not reduced from the 830 kPa (120 psi) operating pressure of the aqueduct and there are no pressure-reducing stations in the main loop within the Eastside/Airfield. The substantially higher water pressure in this area is required for fire protection for Hangars 2 and 3 east of the runways. The required fire flow for these hangars is 38,000 liters per minute (10,000 gpm).

The Eastside/Airfield distribution system contains lines ranging from 200 mm (8-inch) to 250 mm (10-inch) in diameter with several smaller diameter dead ends. The only significant looping in this system is found surrounding the hangars.

[1] John West, NASA, November 6, 2001.

The Eastside/Airfield water system is connected to the NASA Research Park system by one 200 mm (8-inch) line and one 250 mm (10-inch) line, as discussed above.

There is no water storage within the Eastside/Airfield.

2. Reclaimed Water

This section describes existing reclaimed water service at ARC and in the vicinity, as shown in Figure 3.5-2.

a. Overview of Existing System

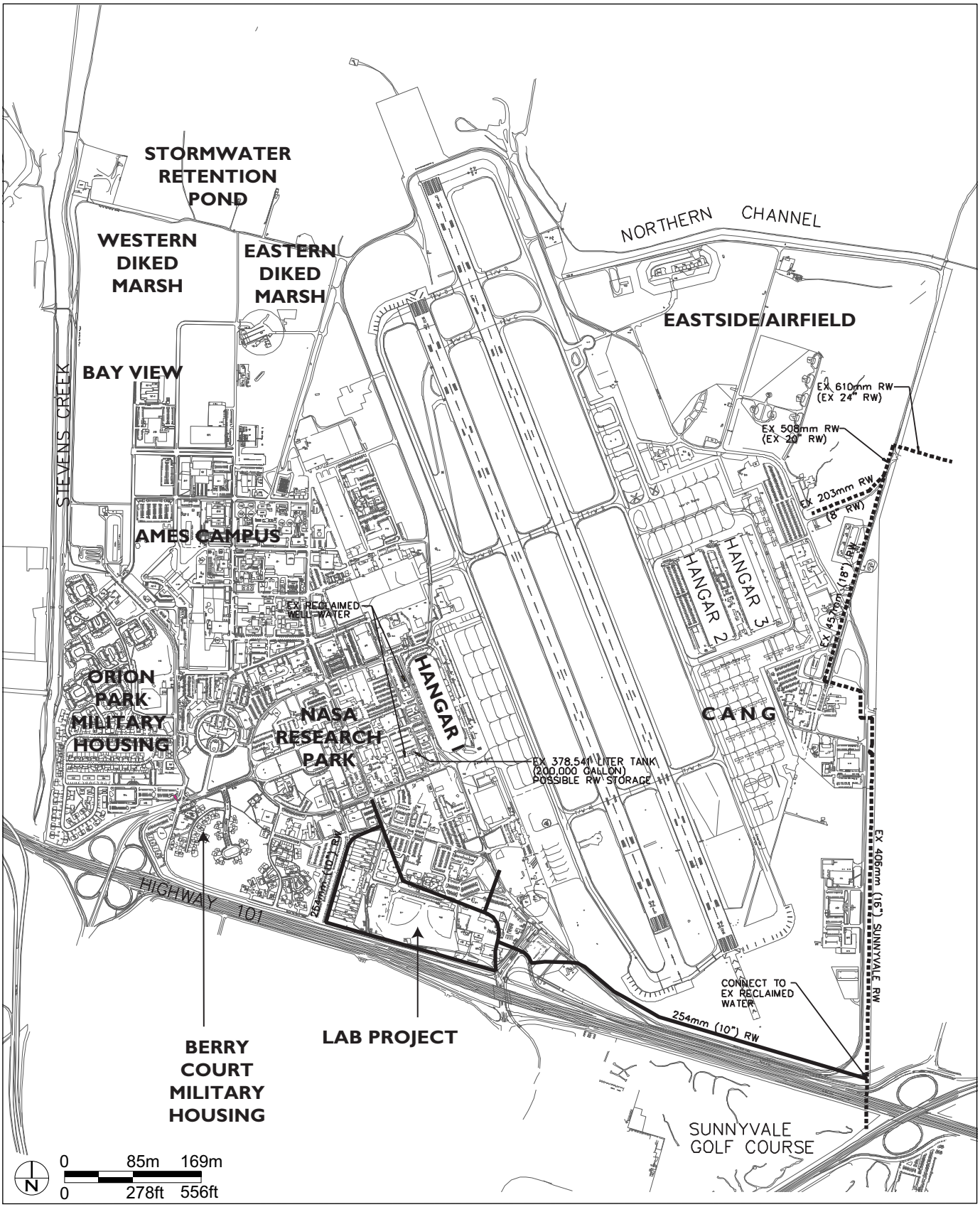
There are four potential sources of reclaimed water available at Ames Research Center. The Navy and MEW reclaimed water is collected and treated on-site as part of ongoing environmental remediation programs. The two neighboring municipalities also have existing or planned reclaimed water systems that could serve Ames Research Center.

b. Navy Reclaimed Water

The reclaimed water provided by the Navy is treated on-site as part of an ongoing environmental remediation program. It is extracted from an aquifer that is contaminated with TCE, PCE and fuel. The treated water meets current drinking water standards. It is planned to use this water for irrigation for the NRP to reduce domestic demand.

c. MEW Reclaimed Water

The MEW reclaimed water, so called because the source of the pollutants is bound by Middlefield Road, Ellis Street and Whisman Road just south of Highway 101, is collected and treated on-site as part of an ongoing environmental remediation program. It is collected from the same aquifer as the Navy reclaimed water but the plume from the MEW area is contaminated primarily with TCE. The treated water meets current drinking water standards. It is planned to use this water in wind tunnel cooling towers to reduce domestic demand.



Source: BKF

Existing Reclaimed Water Mains ▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪

Baseline Reclaimed Water Mains ———————

FIGURE 3.5-2

BASELINE CONDITIONS
RECLAIMED WATER SYSTEM

d. Sunnyvale Reclaimed Water

The Eastside/Airfield is currently serviced by a 610 mm (24-inch) feed from Sunnyvale's reclaimed water system that enters Ames Research Center at the Lockheed Gate, just north of First Avenue. The line tees and is reduced to 510 mm (20 inches), which runs south along East Patrol Road. The main line is reduced again to 460 mm (18 inches) where a 200 mm (8-inch) service line tees off and extends toward the Airfield Substation (Building 591). The main line continues south and is reduced to 410 mm (16 inches) as it runs parallel to Macon Road. The main line leaves Ames Research Center at the southeast corner of the site, near the intersection of Highways 101 and 237. Reclaimed water is not used for irrigation at the Moffett Field Golf Course.

This water is suitable for use as irrigation water. The City of Sunnyvale has indicated that there may be adequate supply available to serve all of Ames Research Center with reclaimed water.

e. Mountain View Reclaimed Water

There is no existing source of reclaimed water available from the City of Mountain View at the current time. However, the City of Mountain View and Palo Alto Regional Water Quality Control Plant have applied for federal funding to construct a reclaimed water line between the treatment plant and Ames Research Center. The City of Mountain View is encouraging the use of reclaimed water for new projects within its service area. This source could be available to serve later phases of development at Ames Research Center.

f. Use of Reclaimed Water in Industrial Process

NASA has recently constructed an Industrial Wastewater Treatment Facility (IWWTF) to remove metals and TDS from industrial wastewater and treated groundwater. The effluent from the IWWTF will be used as makeup water in the boiler for the Arc Jet Facility, and in the Unitary Plan Wind Tunnel cooling tower.

On an annual basis, the IWWTF will provide 10.1 million gallons of makeup water to the Arc Jet boiler, reducing the use of potable water from the SFWD

by 10.1 million gallons. Treatment and reuse of this water also will result in a decrease in discharge to the Palo Alto Regional Water Quality Control Plant of 10.1 million gallons per year.

Normally, the Unitary Plan Wind Tunnel cooling tower is emptied three times per year. This results in another 1 million gallons per year, which will be treated in the IWWTF and reused in the Unitary Plan Wind Tunnel cooling tower, reducing potable water use from SFWD by 1 million gallons per year, and reducing discharge to the Palo Alto Regional Water Quality Control Plant by 1 million gallons per year.

An additional 3.3 million gallons per year of makeup water will be supplied to the Unitary Plan Wind Tunnel cooling tower from the IWWTF, further reducing the use of potable water from SFWD. The source of this water is treated groundwater from the Regional Plume from MEW and NASA extraction wells, which will then be further treated in the IWWTF to remove the total dissolved solids (TDS). Treatment and reuse of this water will also result in a decrease in discharge of Stevens Creek of 3.3 million gallons per year.

In summary, when fully operational, the IWWTF will result in a decrease in potable water use from SFWD of 14.4 million gallons per year, a decrease in discharge of industrial wastewater to the Palo Alto Regional Water Quality Control Plant of 11.1 million gallons per year and a decrease in discharge to Stevens Creek of 3.3 million gallons per year.

3. Sanitary Sewer

This section describes the existing sanitary sewer systems on the east and west sides of Ames Research Center, as shown in Figure 3.5-3.

a. Overview of the Existing System

The oldest sections of the sanitary sewer system were installed in the 1930's. The sanitary sewer infrastructure includes approximately 27,700 meters (90,900 feet) of collection lines in two separate systems.

The first system services the NRP area (including Shenandoah Plaza), the Eastside/Airfield, the California Air National Guard (CANG) area, the southern and eastern portions of the Ames Campus and the Berry Court Military Housing. This system discharges into the City of Sunnyvale sewer system and will be referred to as the eastern sanitary sewer system.

The second system services the Orion Park Military Housing, the remainder of the Ames Campus, and the Bay View area. This system discharges into the City of Mountain View sewer system and will be referred to as the western sanitary sewer system.

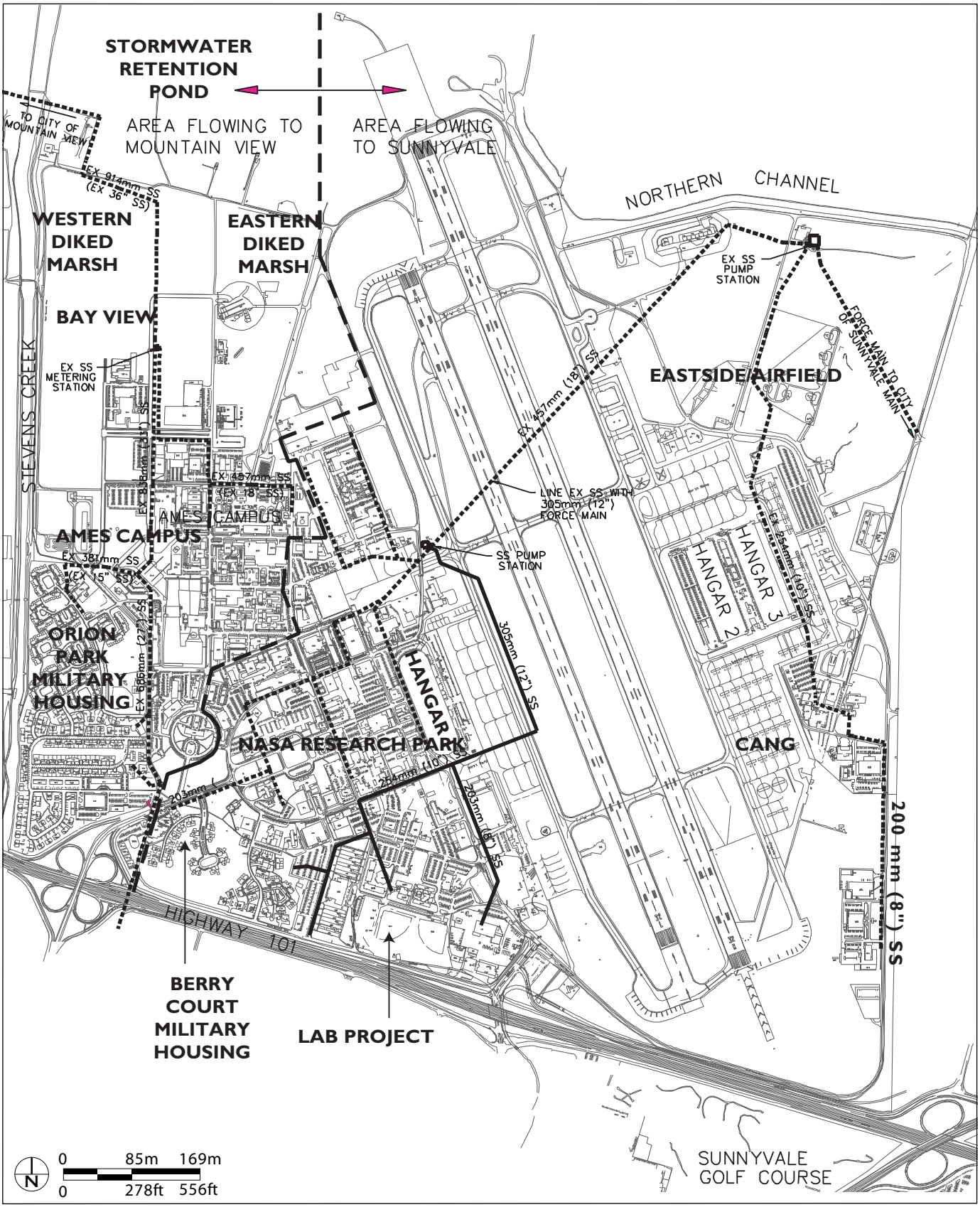
For both systems, the majority of the pipe is vitrified clay and is in need of either rehabilitation or replacement.

b. Eastern Sanitary Sewer System

The eastern sanitary sewer system's main trunk line extends from the southeastern portion of the Ames Campus area to the northeastern portion of the Eastside/Airfield. Collector lines from the NASA Research Park, Berry Court Military Housing, Shenandoah Plaza, and the southern and eastern portions of the Ames Campus feed into this major trunk line. The Eastside/Airfield and the CANG discharge directly into the existing pump station.

Starting at Berry Court Military Housing and the NASA Research Park, the eastern sewer system flows north, through Shenandoah Plaza, in three main lines toward the main trunk line. There are also several smaller sewer lines that flow south and east toward the main trunk line from the northern and eastern portion of the Ames Campus.

The main trunk line, which is a 460 mm (18-inch) pipe, flows northeast and crosses the existing airfield. This main line has the capacity to convey 7,600 liters per minute (2,000 gpm). The total existing peak wet weather flow through this line is estimated to be 4,160 liters per minute (1,100 gpm). After



Source: BKF

Existing Sanitary Sewer Mains .....

Baseline Sanitary Sewer Mains ———

Limits of Municipal Sewer Service Area — — —

FIGURE 3.5-3

BASELINE CONDITIONS SANITARY SEWER SYSTEM

review of a 1995 video log of the sewer pipe, it was determined that the line is in good condition. There are two manholes within the runway infield with 300 mm (12-inch) storm drain pipes through them. The storm drain pipes are sound and the potential for cross contamination appears to be minimal. The storm drain pipes restrict flow when the pipe is flowing more than one quarter full. However, this restriction is minor since the full-flow velocity is only about 0.61 meters per second (2 feet per second). The storm drainage pipes present more of a maintenance problem than a flow restriction as paper and solids could accumulate.

The main sewer line continues northeast until it reaches a pump station located in the northeastern portion of the Eastside/Airfield. The pump station, although still functional, is nearing the end of its useful life. In addition, the design is outdated, so it is expected that the pump station will eventually be completely replaced rather than refurbished. The pump station has a capacity of 7,600 liters per minute (2,000 gpm). Existing peak wet weather flow to the pump station is approximately 4,900 liters per minute (1,320 gpm). This station receives flow from the main line crossing the airfield and the Eastside/Airfield sewer system. From the pump station, sewage is pumped east through a 250 mm (10-inch) force main to an offsite gravity main that continues on to the Sunnyvale Water Pollution Control Plant (SWPCP), located about two miles to the east. The force main and gravity line that convey effluent from the pump station to the SWPCP are reported to be in good condition.

The SWPCP has capacity to treat 112 megaliters per day (29.5 million gallons per day, MGD). The SWPCP currently receives about 62.5 megaliters per day (16.5 MGD), and the City of Sunnyvale has no plans for expansion of the facility. Based on discussions with SWPCP staff, it is anticipated that the existing treatment facility would have sufficient capacity to support the proposed development of Ames Research Center.

NASA's contract with the SWPCP is based on effluent content. The Ames Campus is classified as a metal finisher, and is subject to local and federal

regulations governing heavy metal discharge. The Ames Campus has limited on-site capacity (about 270 liters (70 gallons) per day) in Building N-211 to treat effluent from the Alodine process (metal plating). SWPCP takes monthly samples at six Ames Campus sewer system manholes to monitor effluent content. Samples are tested for pH and heavy metals including cadmium, chromium, lead, arsenic, and selenium.

c. Western Sanitary Sewer System

The western sanitary sewer system's main trunk line enters the site just east of the Moffett Boulevard interchange as a 690 mm (27-inch) line running under Highway 101. The line extends from the freeway, through Ames Campus and the future Bay View area, to a location north of the North Perimeter Road, where it leaves the site. This gravity line is operated by the City of Mountain View and is referred to as the East Trunk in their documents. The line collects wastewater from an area south of Highway 101 before entering Ames Research Center and picks up domestic flow from Orion Park Military Housing, which is unmetered, and industrial flow from ARC, which is metered. North of Building N-255, the 690 mm (27-inch) East Trunk comes to a metering station, where the ARC flow enters. The collection system in ARC has lines ranging in diameter from 200 mm (8-inch) to 460 mm (18-inch). The metering station discharges to a 760 mm (30-inch) main. The pipe diameter increases to 910 mm (36-inch) as the pipe continues north and connects to the Mountain View sanitary sewer system.

The Mountain View East Trunk originally served a large industrial complex to the south of Highway 101, which discharged a high amount of sewage. Since then, recent high tech development has replaced the large industrial sites, resulting in a decrease in sewage flow at the point where the line enters Ames Research Center.

The East Trunk flows to a lift station located near the Mountain View Golf Course. The lift station is already at its 40 megaliters per day (10 MGD) capacity. Wet weather flows exceed the station capacity two or three times a year. When that occurs, the Supervisory Control and Data Acquisition

(SCADA) sensing system automatically shuts down the pumps and closes a slide gate into the lift station. This is referred to as Bypass Mode. Flow is then by gravity to the Palo Alto Regional Water Quality Control Plant. Mountain View is required to notify ARC when this occurs, as flow backs up into the East Trunk line at least as far as the metering station. Mountain View prepared a study of the lift station that recommends continuing to utilize Bypass Mode and expand the downstream piping rather than expand the station capacity.

The Mountain View sewer system conveys flow to the Palo Alto Regional Water Quality Control Plant. This treatment plant is jointly owned by the cities of Palo Alto, Mountain View and Los Altos. Mountain View currently has approximately 38 percent of ownership and capacity. The City of Palo Alto is responsible for administration of the Treatment Plant, whose capacity is approximately 144 megaliters per day (38 MGD) dry weather flow and 303 megaliters per day (80 MGD) peak wet weather flow. Current total peak wet weather flow into the plant is 227 megaliters per day (60 MGD). Mountain View's allocation of plant capacity is 55 megaliters per day (14.4 MGD) dry weather flow and 114 megaliters per day (30 MGD) peak wet weather flow. Currently, Mountain View uses approximately 37 megaliters per day (9.8 MGD) dry weather flow, and 83 megaliters per day (22 MGD) peak wet weather flow.

Ames Research Center has a permit with the Palo Alto Regional Water Quality Control Plant for wastewater treatment. The permit was signed in 1993 and renewed in 1999, and provides for treatment of up to 1.14 megaliters per day (0.3 MGD) peak flow. Current dry weather flow is on the order of 0.8 megaliters per day (0.2 MGD). Wet weather readings indicate a much higher peak flow than actually occurs due to the inundation of the flow meter during large rainfall events, as revealed by examination of the meter reading patterns. Interpretation of the meter readings leads to the conclusion that existing wet weather flow is almost 2.3 megaliters per day (0.6 MGD). The existing wet and dry weather flows are higher than those predicted by Mountain View's 1991 Sanitary Sewer Master Plan.

4. Storm Drainage

This section describes the existing storm drainage system in the two drainage areas within Ames Research Center, as shown in Figure 3.5-4.

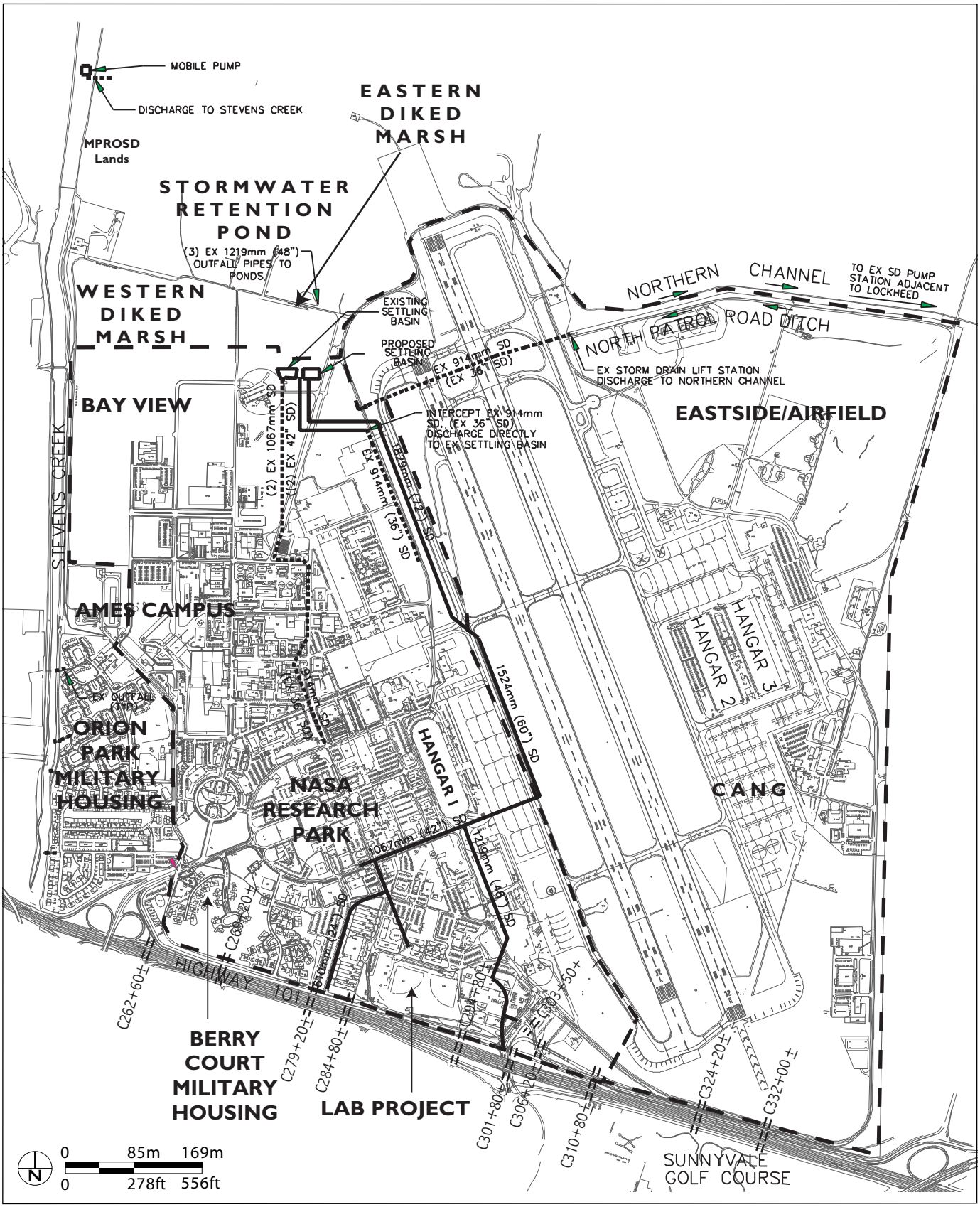
a. Overview of the Existing System

Ames Research Center watershed consists of about 680 hectares (1,690 acres) and is divided into two drainage areas. In addition, an area less than 20 hectares (50 acres), consisting primarily of Highway 101 right of way, discharges into ARC by means of several bubble-up drainage structures and culverts scattered along the southern boundary of ARC. The culvert piping ranges from 450 to 750 mm (12 to 18 inches) in diameter. There are two exposed culverts and eight bubble-ups, which include inlet/outlet structures resembling drainage inlets. On-site storm drain pipe sizes throughout ARC range from 150 mm (6-inch) to 1,070 mm (42-inch).

The first drainage area encompasses approximately 275 hectares (680 acres). The drainage system in this area services the NRP area, most of the Ames Campus, Berry Court Military Housing, and the Bay View area. This drainage system will be referred to as the western drainage system.

The western drainage system discharges into the Storm Water Retention Pond (SWRP) that lies in the north of the Bay View Area. The SWRP has no outfall and during most of the year, water is removed by evaporation only. During the wet season of some years, when flow into the SWRP exceeds the storage capacity, temporary pumps are moved onto the levee on the western edge of the SWRP where water is pumped directly into Stevens Creek. The western portion of the SWRP is owned by the Midpeninsula Regional Open Space District (MROSD).

In the past, Bay View and northern ARC have experienced general flooding due to a combination of inadequate culvert pipe capacity and ground elevations that are low relative to the water level of the SWRP while the remainder of the western drainage area has experienced localized flooding due to inadequate



Source: BKF

Caltrans Culvert/Outlet Location

Existing Storm Drain Mains

Baseline Storm Drain Mains

Drainage Area Boundary

FIGURE 3.5-4

BASELINE CONDITIONS STORM DRAIN SYSTEM

system capacity. Over the past 20 years, several storm drain studies have been completed, all of which agree that major renovation and rehabilitation of the western drainage system should take place. Certain intermediate measures have been taken to protect specific buildings but significant improvements to the underground system have not been made.

The second drainage area encompasses approximately 410 hectares (1,010 acres) in the southeast portion of the NRP area, the Ames Campus facilities next to the runway, the Eastside/Airfield, and the California Air National Guard area. This drainage system will be referred to as the eastern drainage system. There is no direct connection between this area and the SWRP. Local flooding occurs in the northern part of the airfield during peak rainfall events due to lack of adequate drainage capacity.

b. Western Drainage System

The western drainage system begins in the Berry Court Military Housing and NRP area. Eight drainage structures, which serve approximately 14 hectares (35 acres) of Caltrans right-of-way, discharge into the area that is drained by the western drainage system. Stormwater flows north, through Berry Court Military Housing, the NRP area and Shenandoah Plaza, toward the main junction, which is located on the boundary between Shenandoah Plaza and the Ames Campus at the intersection of McCord Avenue and Bushnell Road. Stormwater from a small portion of Orion Park Military Housing flows east toward the same junction. This line passes through Orion Park Military Housing, the Main Gate area and the Ames Campus area.

At the McCord/Bushnell junction, all lines discharge into a 910 mm (36-inch) main trunk line. Stormwater then flows north through the Ames Campus area. Several other storm drain lines, located in the Ames Campus area, discharge into this main line as it flows north.

At the border of the Ames Campus area and the Bay View area, the 910 mm (36-inch) main line discharges into two 1,0 70 mm (42-inch) pipes. These pipes flow north, through the Bay View area, toward a settling basin located in the

northeastern portion of Bay View. From the settling basin, stormwater is discharged into the Eastern Diked Marsh, located just north of Bay View. The stormwater is drained by three 1,220 mm (48-inch) culverts under North Perimeter Road. These culverts convey flows from the Eastern Diked Marsh to the SWRP.

The water in the SWRP has no outlet except evaporation. Therefore, when inflow into the SWRP is expected to exceed storage capacity, mobile pumps are used to discharge excess water into Stevens Creek, which flows from south to north along the western edge of Ames Research Center. The pumps are not automated and are brought out to the SWRP during flooding or when conditions are favorable for flooding. During the wet season, once the storage capacity of the SWRP is fully utilized any runoff discharging into the SWRP that exceeds the rate at which the mobile pumps can remove water from the SWRP will result in water backing up causing inundation of the wetlands in northern ARC and localized flooding in Bay View. The capacity of the mobile pumps is less than 0.30 cubic meters per second (10 cfs), which is much less than the peak runoff of 6.2 cubic meters per second (220 cfs) from the 2-year storm for the 275-hectare (680-acre) area that currently discharges into the SWRP.

In the past, localized flooding in the Ames Campus area has been caused by inadequate inlet/pipe capacity. This occurs because the Ames Campus drainage system has not been improved as the Ames Campus has expanded. During a more intense storm, the inlets do not allow enough water to enter the system, thus causing surface flooding. At the same time, the water that does enter into the system exceeds the capacity of the pipes, due to the fact that the pipe capacity is limited to a 2-year storm, and the pipes surcharge. When this occurs, even less surface water enters the system, which increases the degree of flooding.

c. Eastern Drainage System

The eastern drainage system begins in the southern portion of ARC and the southern portion of the CANG. Two drainage structures, which serve approximately 6 hectares (15 acres) of Caltrans right-of-way, discharge into the

southern portion of the airfield. Storm water from the airfield and the CANG travels north through several storm drain lines and via random overland flow. Overland flow from the northeastern portion of the airfield (currently occupied by the golf course) is collected by a small concrete-lined channel that flows west toward the Moffett Field storm drain lift station, which is located at the northeast corner of the airfield. This channel is commonly referred to as North Patrol Road Ditch. It is separated from the Northern Channel, which flows east, by a levee. The levee was recently raised to prevent flow in the Northern Channel (downstream of the lift station) from discharging into the smaller channel and flowing back into the lift station.

The southeastern portion of the NRP also contributes to the eastern drainage system via a main line that flows north, near the western most portion of the airfield. As this line continues north along Zook Road, it picks up several smaller lines from the eastern portion of ARC. Just south of North Warehouse Road, the line reaches its ultimate size of 910 mm (36-inch) in diameter. This provides a flow capacity of about 1.1 cubic meters per second (40 cfs) which would allow it to convey runoff from an 11-hectare (26-acre) drainage area during a 25-year storm event with no surface ponding. It is currently draining a much larger area and localized flooding has resulted. The 910 mm (36-inch) main line turns east, crossing the airfield, to the Moffett Field storm drain lift station, which is located at the northeastern section of the airfield.

Stormwater from the 910 mm (36-inch) main and the North Patrol Road Ditch, along with shallow groundwater, discharge into the lift station. The lift station consists of two 15kW (20 horsepower) pumps and has a capacity of approximately 45,000 liters per minute (12,000 gpm). Water is pumped into the Northern Channel, which flows east off of the site and runs along the northern boundary of the Lockheed site. Two 19,000 liters per minute (5,000 gpm) portable pumps are located at intermediate points along North Patrol Road Ditch and discharge directly into the Northern Channel. Therefore, the total peak discharge into the Northern Channel as it leaves the site is 83,000 liters per minute (22,000 gpm) or 1.40 cubic meters per second (49 cubic feet per second, cfs). The Northern Channel connects to the easternmost Lockheed

pond, adjacent to the Moffett Channel (Sunnyvale West Side Channel), through a 1,220 mm (48-inch) diameter culvert. A pump station with three pumps lifts the water into the Moffett Channel where it flows by gravity into San Francisco Bay. This pump station serves another 267 hectares (660 acres) of land east of Ames Research Center and has a total capacity of 117,000 liters per minute (31,000 gpm) or 1.95 cubic meters per second (69 cfs).

5. Electrical Service

This section describes the existing electricity distribution system in the four planning areas, as shown in Figure 3.5-5.

a. Overview of the Existing System, Including Substations

Ames Research Center receives electrical power from the United States Department of Energy, Western Area Power Administration (WAPA). If WAPA's allocated power is exceeded, NASA buys the balance from Pacific Gas & Electric (PG&E). WAPA provides electrical power to governmental agencies and municipalities.

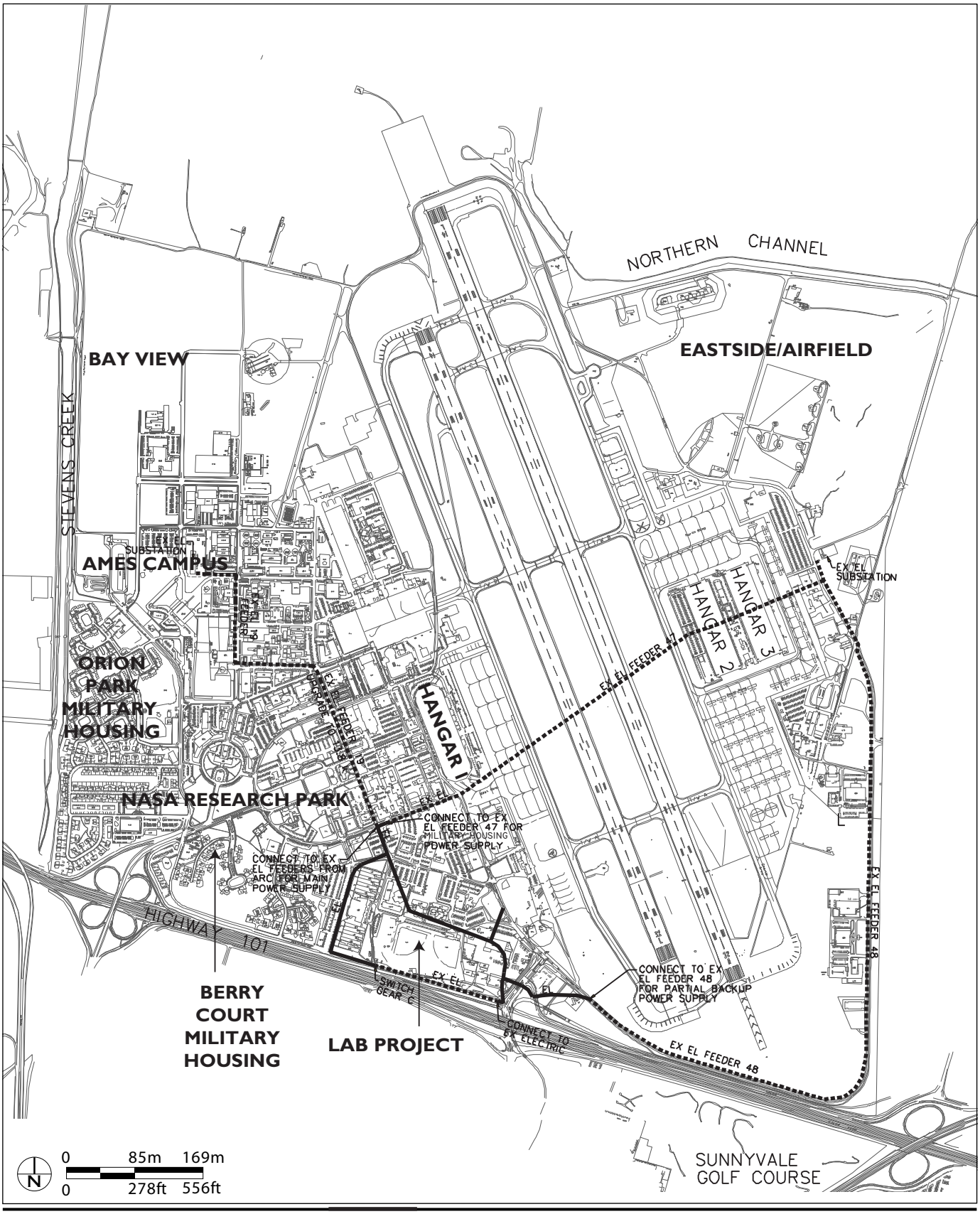
Ames Research Center is served by two electrical substations. The ARC substation was constructed in the 1940's and is centrally located in the Ames Campus area. It receives power from two PG&E 115kV overhead transmission lines that are dedicated exclusively to ARC, terminating at bus structures A and B. The bus structures serve as the main distribution point to 17 outdoor transformers that step-down from 115kV to various secondary voltages (13.8kV to ARC, 12kV feeder to the NRP area, and 6.9kV and other special voltages specific to lab testing). The 17 outdoor substation-type transformers have a total rating capacity of approximately 650 MVA. Of this total, 600 MVA (92 percent) are substation-type transformers dedicated only to serve specific lab buildings and their large motor loads. The remaining 50 MVA is used to provide typical electrical service (lighting, HVAC, receptacles and miscellaneous loads) to the buildings located throughout the Ames Campus.

In accordance with the contract with WAPA, the maximum rate of delivery to the ARC substation is 80 MW at a power factor of 0.95 or better. Full

utilization of the existing buildings served by the ARC substation would create a demand of nearly 36 MW for general (non-lab) applications. However, reduced occupancy of the existing buildings has dropped the demand to about 20 MW.

In addition to serving the Ames Campus, the ARC substation currently provides emergency backup 12kV power to the switchgear located in the NRP area (designated Switchgear C) via Feeder 19 (estimated capacity 6.5MVA), which runs through Shenandoah Plaza along McCord Avenue.

The second electrical substation was constructed in the early 1980's and is located in the Eastside/Airfield, northeast of the hangars. This substation was originally dedicated to serve the Naval Air Station, which included the airfield, the NRP area (including the Shenandoah Plaza Historic District), and Military Housing to the south and to the west of ARC. It receives power from a single PG&E 115kV overhead transmission line that also provides power to the Lockheed property to the east. The 115kV line terminates at a 115-12kV substation at a dead-end structure and one 115kV oil circuit breaker that serves two step-down transformers, each rated at 7.5/9.9 MVA. The secondary side (12kV) of both transformers terminates to a main breaker rated at 15kV, 500MVA, 1200 Amperes. The two mains, one tie and seven feeder breakers are housed in an outdoor walk-in enclosure which is designated Switchgear A. The substation and its related equipment appear to be in good condition. The total transformer capacity is approximately 20 MVA. In accordance with the contract with WAPA, the maximum rate of delivery to the Eastside/Airfield substation is 5,009 kW at a power factor of 1.0, which translates to 5.01 MVA. Full utilization of the existing buildings served by the Airfield substation could create a demand of up to 5 MW. Current existing demand is about 3.5 MW.



Source: BKF

Existing Electric Service Feeders ·····

Baseline Electric Service Feeders ——

FIGURE 3.5-5

BASELINE CONDITIONS ELECTRIC SYSTEM

In addition to serving the Eastside/Airfield, this substation provides power to Switchgear C through Feeder 47 (estimated capacity 6.7MVA), which crosses the runways near the hangars, and Feeder 48 (estimated capacity 5.2MVA), which runs south from the substation along Macon Road, around the southern end of the runways, and west to Switchgear C. Should maintenance be necessary on any of the 115kV equipment, all facilities served by this substation would experience a forced power outage so that required repair work can be done.

b. NRP Area

As described above, there are three major 12kV incoming feeders that serve Switchgear C, which is located in the NRP area at the northwest corner of the intersection of Bailey Road and South Perimeter Road. Due to the feeder sizes, the operation will require both Feeders 47 and 48 to be energized at Switchgear C in order to provide a total of 11.2 MVA of load capacity. Feeder 19 is a backup and can only provide power to Switchgear C if the other two feeders' circuit breakers are locked-out and in the open position. Switchgear C was installed in the mid 1980's and is in relatively good condition.

The existing underground electrical distribution system in the NRP area is a mixture of terra cotta (maximum size 89 mm (3.5-inch)), transite and PVC conduits (127 mm (5-inch) for recent construction, with the majority at 100 mm (4-inch)). Upgrading to a larger cable size in existing conduits is limited to the existing diameter size of the conduit. From a safety standpoint, many of the manholes are overcrowded with cables and too small to accommodate the existing cabling system. The 12kV system is incompatible with the 13.8kV system in ARC.

Switchgear C provides power to the Military Housing areas, the runway lighting, and an antiquated low-voltage system that serve about 25 buildings within the NRP area. Voltage for this system is stepped down from 12 to 2.4kV at Switchgear E located at the corner of Wescoat Road and McCord Avenue. NASA has recently completed a construction project that installed eleven 15kV pad-mounted distribution switches throughout the site. These

distribution switches will be the points of connection for the existing building transformers, when the conversion from 2.4kV is made.

Many of the 2.4kV system feeders were installed utilizing paper-insulated lead cables, which are still in the underground ductbank system. Lead is considered to be a hazardous waste material and hence disposal must be in accordance with EPA regulations. Most of the transformers, switchgears, cables and related components for the 2.4kV system are reaching or have exceeded their life expectancy. In some cases, oil fuse cutouts/switches and cable-link boxes are still in service and are considered a safety hazard by today's standards. It has long been the intention of the Navy and NASA to phase out the 2.4kV system.

In general, performing any maintenance on the distribution feeders in the NRP area causes service to many buildings to be interrupted because all of the existing distribution feeders are radial-feed.

c. Ames Campus and Bay View Areas

The ARC substation is described above. The ARC substation equipment and distribution system is over 40 years old. Typical service life for medium and high voltage equipment is 20 to 30 years. It is expected that the maintenance cost for maintaining this electrical system will increase as each year goes by. The Electric Power Office (EPrO) was formed in the late 1990's in order to improve safety and prevent catastrophic failures of ARC's aging electrical infrastructure.

Recent improvements to the system include:

- Replacement of antiquated 115kV Oil Circuit Breakers.
- Repair of transformers T-45 and T-46.
- Power monitoring system has been replaced.
- A program of maintenance and regularly scheduled replacement has been instituted for the protective relaying system on high and medium voltage systems. Almost all of the 115kV protective relays have been replaced

with modern microprocessor components with the remainder of the systems to be replaced as needed.

- Replacement of transformer T44.

Additional planned improvements include:

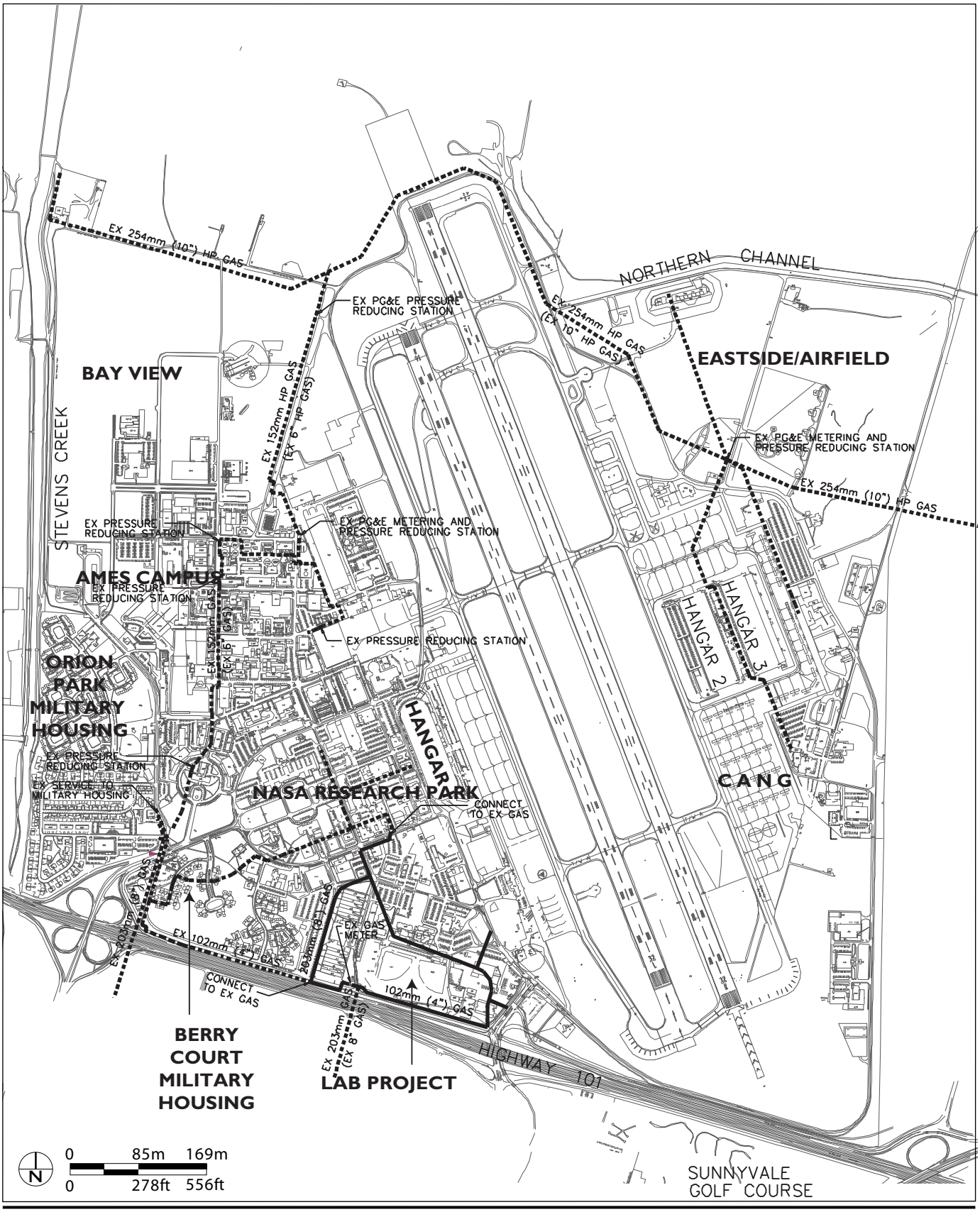
- Recently retrofitted 15kV class Air Circuit Breakers (SF6) are scheduled to be replaced.
- Replace 70 percent of lead cable.
- Replace building service transformers, primary switchgear and secondary switchboards.
- Replace all underground distribution switches in manholes with above ground distribution switches.
- Convert the 7.2kV distribution system to 13.8kV.

Once these improvements are complete, the only major remaining deficiency will be the undersized and deteriorated underground ductbank system.

The distribution for the Ames Campus area operates at 13.8kV and 7.2kV, and consists of an underground ductbank system that is made up of cables, conduits and manhole vaults. There are distribution-type transformers located in or near buildings that step down the distribution voltage to utilization level (480/277 Volts, 208/120 Volts). There are more than 100 distribution transformers located throughout the site of various kVA rating and types (oil, dry).

d. Eastside/Airfield

The substation located in the Eastside/Airfield area is described above. The distribution for the Eastside/Airfield operates primarily at 12kV with some vestigial 2.4kV portions. Switchgears B and D are located on Feeder 47 near the hangars and provide power to the buildings in this area. A 12kV distribution system extends southward, eventually running parallel to Feeder



Source: BKF

Existing Gas Mains ----------

Baseline Gas Mains ——————

FIGURE 3.5-6

BASELINE CONDITIONS GAS SYSTEM

48 along Macon Road, providing power to the California Air National Guard facilities.

6. Natural Gas Service

This section describes the natural gas delivery system in each of the four planning areas, as shown in Figure 3.5-6.

a. Overview of the Existing System

Ames Research Center's natural gas supply is purchased from the Defense Energy Support Center (DESC) and transmitted to the site by Pacific Gas and Electric (PG&E) through two main service lines. The first is a 250 mm (10-inch) high pressure (2,070 kPa (300 psig)) east-west line that branches off to a 150 mm (6-inch) north-south line that is lower in pressure, but at 970 kPa (140 psig) is still considered high pressure. The 250 mm (10-inch) line enters into Ames Research Center north of the Bay View area and extends east, around the north portion of the Eastside/Airfield, through the golf course and out of Ames Research Center. The north-south line branches off of the 2,070 kPa (300 psig) line and extends south to a PG&E-owned pressure-reducing station, located near the intersection of Lindbergh Avenue and North Perimeter Road. At this station, pressure is reduced from 2,070 kPa (300 psig) to 970 kPa (140 psig). The line continues south, through the Bay View area, to a PG&E pressure-reducing and metering station located in the Ames Campus, and continues into the Berry Court Military Housing area and out of Ames Research Center under Highway 101. This line services the Ames Campus.

The second service line enters Ames Research Center in a separate crossing under Highway 101. The metering station (G27) for this service is located at the northwest corner of Bailey Road and South Perimeter Road and it serves the NRP area and Berry Court Military Housing.

Another line crosses under Highway 101 and onto Front Street. It serves Orion Park Military Housing, which is not part of Ames Research Center. Berry Court Military Housing is tied to the NASA Research Park natural gas system. Although both Berry Court Military Housing and Orion Park

Military Housing are mentioned, they are outside the scope of this section except as they impact Ames Research Center utility systems.

There are several metering stations throughout the site that monitor specific areas. The gas flow through each of the metering systems varies, depending upon the demand of the area served. Ames Research Center purchases natural gas directly from the producers via the Defense Energy Support Center and a transmission fee is paid to PG&E to transport the natural gas from the producers to Ames Research Center.

b. NRP Area

The NRP area is supplied natural gas through a 100 mm (4-inch) steel pipe. The capacity of this service connection is roughly 150,000 cubic meters per hour (5.3 million cubic feet per hour) provided that adequate supply is available. The gas piping branches off to a different distribution network to supply natural gas to various buildings. The incoming nominal pressure to the metering station, located at Bailey Road and South Perimeter Road, is 450 kPa (65 psig) and is then reduced down to 117 kPa (17 psig) nominal pressure at the downstream portion of the metering station. The natural gas distribution system is considered a medium pressure system.

The NRP area's natural gas distribution system appears to be in fair condition. Some of the existing steel pipes have been replaced with polyethylene pipes due to corrosion and gas leakage problems. Most of the steel pipe replacements took place west of Bailey Road. Pipe corrosion occurred due to aging pipelines and a high water table in the area. Some of the gas valves were inoperable and had to be replaced throughout the area due to leakage, with other valves scheduled to be replaced in the future.

The main natural gas meters appear to be in good condition. Various buildings have sub-meters, which appear to be in good condition. Other buildings, throughout the site, have pressure regulators without gas meters on the supply piping.

The primary use of the natural gas is for space heating in offices, housing, barracks, shops and training centers. Additional gas consumers include cooking equipment, water heaters and a boiler plant.

c. Ames Campus and Bay View Areas

The main PG&E piping is considered a high-pressure natural gas piping system. The capacity of this line is roughly 552,000 cubic meters per hour (19.5 million cubic feet per hour) provided that adequate supply is available. PG&E has a pressure-reducing station near the intersection of Lindbergh Avenue and North Perimeter Road where the pressure is reduced from 2,070 kPa (300 psig) to 970 kPa (140 psig) nominal pressure. ARC's main pressure reducing station, located at the intersection of Mark Avenue and Hunsaker Avenue, reduces the gas pressure from 970 kPa (140 psig) to 410 kPa (60 psig) nominal pressure. The incoming nominal pressure to the metering station is 410 kPa (60 psig) and is further reduced to 140 kPa (20 psig) nominal pressure at the downstream portion of the metering station. ARC's natural gas distribution system is considered a medium pressure system. Several other pressure-reducing stations regulate the pressure down further to operating pressures in the range of 48 kPa (7 psig) to 100 kPa (15 psig).

The Ames Campus area is supplied natural gas through a 200 mm (8-inch) steel pipe, which is reduced to 150 mm (6-inch) and 100 mm (4-inch) steel piping loops throughout the area. The natural gas distribution system in ARC appears to be in fair condition. Ongoing maintenance has kept the system in good working order. Some of the existing steel pipes have been replaced with polyethylene pipes due to corrosion and gas leakage. Some of the gas valves have also been removed and replaced. In addition, some of the pipes were abandoned and rerouted.

The primary use of natural gas is for heating offices and research facilities, domestic water heaters, and a boiler plant in one of the research facilities.

d. Eastside/Airfield

The Eastside/Airfield is supplied natural gas through a 250 mm (10-inch) PG&E trunk line, which is located at the north end of the airfield. The pressure in this line is 2,070 kPa (300 psig). A line extends off of the main line to a pressure reducing station where the pressure is reduced from 2,070 kPa (300 psig) to 970 kPa (140 psig). The capacity of this line is roughly 221,000 cubic meters (7.8 million cubic feet) per hour provided that adequate supply is available. After metering, the pressure is further reduced from 970 kPa (140 psig) to 410 kPa (60 psig). Several other pressure-reducing stations regulate the pressure down further to operating pressures in the range of 48 kPa (7 psig) to 100 kPa (15 psig).

The primary use of natural gas is for heating domestic water and for space heating in buildings.

C. Future Baseline Conditions

Under baseline conditions, new development will occur at ARC under both the CUP and CANG EA's. This section describes new infrastructure that will be built as part of the approved CUP projects.

1. Water

Baseline development in the NRP area will occur in areas that require rebuilding the existing water distribution piping. In addition, the water distribution system in NRP is in poor condition and is operating at a lower pressure than that required for the baseline development. For this reason, a new connection to the existing 460 mm (18-inch) diameter line at Tyrella Street will be installed. New water distribution piping that follows the baseline street layout will also be installed and sized to provide adequate capacity for baseline development. New connections to the existing water distribution piping will be provided, along with pressure regulating valves to accommodate pressure differentials. A 305 mm (12-inch) main south of the airfield will connect to the existing 610 mm (24-inch) water line at the southeast corner of Ames Research

Center to provide a looped system. Because domestic water demands are significantly less than the demands for fire protection, flow rate for fire fighting will be used to design the distribution piping system.

Emergency water supply is required to provide fire flow for the duration of the fire plus operational storage. Fire demand in each development area is 11,000 liters per minute (3,000 gpm) for 4 hours. This assumes that all new and renovated buildings will be equipped with a fire sprinkler system; if no sprinkler systems were installed, the demand would be greater. A 3.2 million liter (850,000-gallon) storage tank with a pump distribution system will be installed as an emergency water supply in the NRP area.

Because of the use of reclaimed water for irrigation and the utilization of low flow plumbing fixtures, potable water demand will decrease with the baseline development. The annual potable water demand will decrease by 29 million liters (7.7 million gallons) and the peak potable domestic (non-fire) water demand will decrease by 380 liters per minute (100 gpm).

2. Reclaimed Water

Under baseline conditions, a new connection to the existing 410 mm (16-inch) diameter reclaimed water line at the southeast corner of Ames Research Center will be installed and a 250 mm (10-inch) main extended into the NRP. New reclaimed water distribution piping that follows the baseline street layout will be installed in the new development.

3. Sanitary Sewer

New sewer collection piping will be installed following the proposed street layout for new development in the NRP area. A main will be installed in Wescoat Road to intercept the flow and direct it east toward the airfield past the West Parallel, then north in the utility corridor along the western edge of the airfield. This line will terminate at the proposed sewer pump station located northeast of Hangar 1. The pump station will discharge into the existing 460 mm (18-inch) gravity line that crosses the airfield. This gravity line will be converted to a force main by lining the existing line from the new

pump station to the existing pump station located northeast of the airfield. The installation of the force main addresses several issues. The first is the interception of the 460 mm (18-inch) line by the proposed storm main running north from the NRP area to the SWRP. The second is the presence of storm drain pipes in two of the manholes in the 460 mm (18-inch) line. A force main could be directed under these three obstructions. Installing a force main will also eliminate the potential for both I/I in this line and the deposition of solids in the line during low flows, which can be a maintenance problem.

The baseline development will not increase sewer discharge due to the reduction in I/I from the installation of new piping.

4. Storm Drainage

Under baseline conditions, new development located at the southern end of the NRP will create conflicts with the existing storm water collection piping. A new storm drain system will be constructed to accommodate the new site layout. The quantity of storm runoff will not increase significantly as a result of the baseline development. However, the existing storm main that drains this area and runs north through the Ames Campus cannot accommodate the existing storm runoff. Therefore, a new system will be constructed that diverts storm water around the Ames Campus. With the new drainage system, run-off from the NRP will be intercepted prior to entering Shenandoah Plaza by a 1070 mm (42-inch) main located in Wescoat Road and directed east toward the airfield. The interceptor will extend east past the West Parallel in the airfield, and then run north along the western edge of the airfield, eventually discharging into a new settling basin adjacent to the existing settling basin north of Ames Campus. This alignment will avoid the crossing conflicts associated with any alignment through the Ames Campus area.

5. Electrical Service

Under baseline conditions, new development located at the southern end of the NRP area will create conflicts with the existing electrical distribution system, including the three feeders serving Switchgear C (Building 590) in the NRP area. The feeder from the ARC substation currently provides 12kV back-up

power to Switchgear C. Switchgear C in turn provides feeders back to Shenandoah Plaza and the Berry Court Military Housing area. Under baseline conditions, the feeder to Switchgear C will be relocated from the area where the laboratory project is being constructed. The feeders from the Airfield substation to Switchgear C will be upgraded to 13.8kV and will provide backup power to that switchgear. The baseline development will also require the installation of a new electrical distribution system to serve the new development and maintain service to existing buildings.

The baseline development will increase demand for electricity by 6.6 MW to a total demand of approximately 43.3 MW (without allowing for wind tunnel operations).

6. Natural Gas Service

Under baseline conditions, new development located at the southern end of the NRP will create conflicts with the existing natural gas distribution system and will require the installation of new piping.

The baseline development will increase demand for natural gas by 58,000 giga-joules (550,000 therms) per year to a total of 400 million giga-joules (4 million therms) per year.

D. Infrastructure Within City Boundaries

NASA Ames has historically installed, maintained, and improved its infrastructure in the portions of ARC that are within the City of Mountain View and the City of Sunnyvale boundaries. NASA plans to continue this in the future.